A WOODY STEM IN MERREMIA GEMELLA INDUCED BY HIGH WARM WATER

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In the large swamp a little west of Los Baños, Laguna, Philippine Islands, *Merremia gemella* (Burm.) Hallier f. (Convolvulaceae) is a common vine which sometimes grows over *Phragmites vulgaris* (Lam.) Trin. and Sesbania (nearest *S. sesban* (L.) Merr.). As both of these species grow in water the greater part of the year and Merremia is neither a parasite, like Cuscuta, nor an epiphyte, its roots must also be under water. This is not a normal condition for Merremia but it does adapt itself and lives. Consequently, even near the center of the swamp, one finds festoons of Merremia draped over the Phragmites and Sesbania, even when they are growing in water a meter deep.

Usually the stem of *Merremia gemella* in dryland thickets and as a weed in cultivated land is herbaceous and dies down each year. Under the conditions obtaining in the swamp, the first and perhaps most striking thing seen is the prominent woody stem which may be as much as 20 mm. in diameter.

As a seedling Merremia must start in the ground and is continually dependent upon the ground for certain mineral salts. The seedling develops into a vine, rapidly making its way to the upper story of vegetation and spreading out over whatever happens to be there. To do this the normal herbaceous stem appears to be sufficient under ordinary conditions. Most of the swamp area is submerged during the rainy season, so that the roots of Merremia are under water. In ordinary years they are not generally far under water—less than 25 cm. rather than more. The sources of the water in the region are bubbling hot springs, whose temperature is usually between 70 and 90° C. The water soon becomes cooled to a temperature between 30 and 40° C., which several plants withstand.

The high water of 1914 was very high,—more than 1.5 meters over considerable area. The water covered the hot springs, which however continued to heat up the water in their vicinity. In the immediate vicinity of the hot springs the plants were killed outright

and deleterious effects spread considerably further. Six weeks later, at the end of October, the temperature of the water a kilometer away from the hot springs was 27° C., whereas the surface water over them was 37 to 42° C.

All of the Merremia in the vicinity of the hot springs was killed. Further away where the temperature did not go much above 30° C. the effect was to stimulate the growth of a woody stem. The secondary thickening was very irregular, forming what is known as anomalous structure. Beneath the warm water level, there was only a very little secondary thickening present, of the same general type as that above

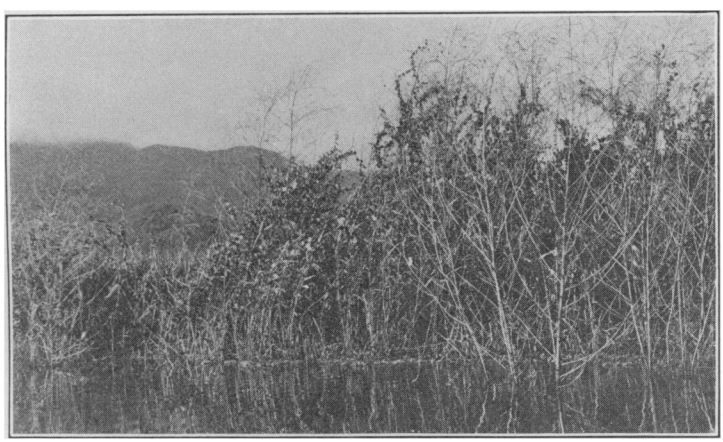

FIG. 1. The edge of the creek in the center of a swamp, showing *Merremia gemella* climbing on *Sesbania*. *Sesbania* in fruit is nearly leafless. Los Baños, P. I. October 31, 1914.

the water but much poorer in amount and diversity of anomalous structure. The xylem vessels were noticeably larger in the part of the stem above the water. The bark above the water was rugged, but beneath the water it was quite smooth and compact. It was frequently covered with putrifying bacteria, but did not produce aerenchyma. When the stem was submerged during only the highest part of the high water and especially when it was twining around a stem of Sesbania, at the places where aerenchyma was produced by the Sesbania, short (less than 25 mm.), horizontal, clinging roots were developed from the stem of the Merremia. Entirely above the water

where no aerenchyma was produced by Sesbania, no clinging roots were present on the Merremia. These roots closely covered the aerenchymatous surface but did not seem to penetrate it.

Lack of sufficient air in the lower part of the stem and in the roots was obvious. The smaller size and number of the vessels in the lower part, the simpler structure as well as the smaller amount of

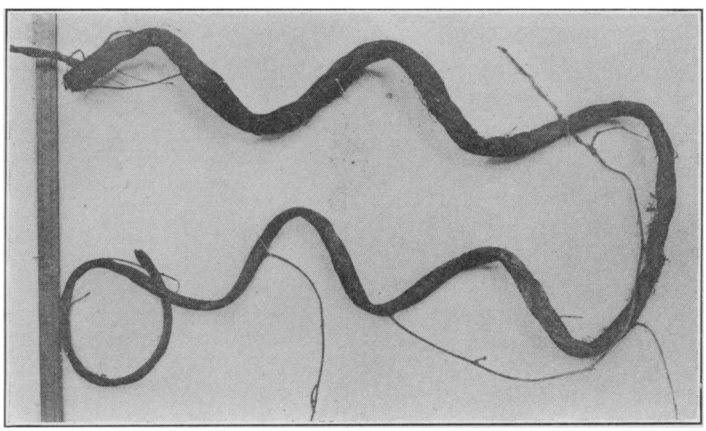

FIG. 2. A piece of the stem of *Merremia gemella* from near the center of the swamp. The upper and larger part was not submerged, while the lower and thinner part was covered with warm water. Los Baños, P. I. October 31, 1914.

starch present in the lower part of the stem showed that the conduction of the food downwards was also affected by the continued submergence of the stem in the warm water. The results were somewhat similar to girdling in that the phloem was very much congested in the upper part of the stem.

If the roots developing from the stem had penetrated the supporting host, a first stage in the development of parasitism would have been apparent, but such was not the case.

Of a number of stems measured, the lowest part, which was beneath the water, varied from 4 to 10 mm. in diameter, while that above the water was from 10 to 20 mm. in diameter. The greatest difference found in a single plant was 6 mm. beneath and 18 mm. above the medium high water level.

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